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Electric Vehicle Fleet Operators in the Energy Market - Feasibility and Effects on the Electricity Grid

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Abstract : The transition to electric vehicles (EVs) stands at the forefront of innovative strategies designed to address environmental concerns and reduce fossil fuel dependency. As the number of EVs on the roads increases, so too does the potential for their integration into energy markets. This research dives deep into the transformative possibilities of using electric vehicle fleets, specifically electric bus fleets, not just as consumers but as active participants in the energy market. This paper investigates the feasibility and grid effects of electric vehicle fleet operators in the energy market. Our objective centers around a comprehensive exploration of the sector coupling domain, with an emphasis on the economic potential in both electricity and balancing markets. Methodologically, our approach combines data mining techniques with thorough pre-processing, pulling from a rich repository of electricity and balancing market data. Our findings are grounded in the actual operational realities of the bus fleet operator in Darmstadt, Germany. We employ a Mixed Integer Linear Programming (MILP) approach, with the bulk of the computations being processed on the High-Performance Computing (HPC) platform 'Lichtenbergcluster'. Our findings underscore the compelling economic potential of EV fleets in the energy market. With electric buses becoming more prevalent, the considerable size of these fleets, paired with their substantial battery capacity, opens up new horizons for energy market participation. Notably, our research reveals that economic viability is not the sole advantage. Participating actively in the energy market also translates into pronounced positive effects on grid stabilization. Essentially, EV fleet operators can serve a dual purpose: facilitating transport while simultaneously playing an instrumental role in enhancing grid reliability and resilience. This research highlights the symbiotic relationship between the growth of EV fleets and the stabilization of the energy grid. Such systems could lead to both commercial and ecological advantages, reinforcing the value of electric bus fleets in the broader landscape of sustainable energy solutions. In conclusion, the electrification of transport offers more than just a means to reduce local greenhouse gas emissions. By positioning electric vehicle fleet operators as active participants in the energy market, there lies a powerful opportunity to drive forward the energy transition. This study serves as a testament to the synergistic potential of EV fleets in bolstering both economic viability and grid stabilization, signaling a promising trajectory for future sector coupling endeavors.

Keywords : electric vehicle fleet, sector coupling, optimization, electricity market, balancing market
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